

Paper:

Efficiency Improvement of Information Acquisition in PC Operation with Auditory Signal

Hirohiko Honda* and Kazuko Tobita**

*Applied Computer Sciences, Shonan Institute of Technology
1-1-25 Tsujido-Nishikaigan, Fujisawa, Kanagawa 251-8511, Japan
E-mail: honda@center.shonan-it.ac.jp

**Shonan Institute of Technology
1-1-25 Tsujido-Nishikaigan, Fujisawa, Kanagawa 251-8511, Japan

[Received May 23, 2011; accepted September 5, 2011]

When using a personal computer (PC), the visually impaired and patients who have difficulty in maintaining a posture have a hard time in utilizing applications that rely on the state of the screen or GUI. In this study we designed a system that uses auditory signals effectively so that the changes in sound, rhythm, and tone enable the users to understand the current state and recognize transition of states. We focus on a mailing tool this time and make auditory signals selectable according to user characteristics by modifying artificial auditory signals that are similar to environmental sounds and combining them with voice synthesis. We discuss the meaning of the assistive tool that depends less on the screen.

Keywords: human interface, assistive technology, adaptation, soundscape

1. Introduction

Some patients with intractable diseases such as muscular dystrophy, Spinal Progressive Muscular Atrophy (SPMA), Fibrodysplasia Ossificans Progressive (FOP), and Amyotrophic Lateral Sclerosis (ALS) have range of motion of the body that gradually loses freedom as the disease progresses, and depending on the condition of the disease it becomes difficult for them to work continuously or maintain posture. Use of PC is highly beneficial to them that they can use Braille and voice synthesis to input and output various information by themselves regardless of screen.

On the other hand, current PCs that depend highly on GUI, require users to operate a mouse while viewing the screen, thus no work can be done unless the user understands the screen configuration. There have been attempts to overcome this problem such as GUI access technology [1] called a screen reader with which screen information is read out and various other input assist devices [2].

However, even though vision-independent operations are possible, those methods require the screen to be read

out in sequence for the user to select and determine the operations and therefore advantages of the GUI, i.e., list display and intuitive operations, are not fully utilized. There is a study on a technique to express the GUI screen layout with a three-dimensional sound configuration for intuitive operations [3] but the screen status can only be determined by mouse operations and cannot be determined in a static state where nothing is operated. Patients having difficulty in maintaining their posture cannot keep setting in front of the display for more than a certain length of time, and thus a length of time that they take their eyes off the screen becomes longer. This means that they need to reconfirm the state of where the pointer is focusing, thereby reducing efficiency from viewing the screen again to determine the state and decide on the action.

One of the characteristics of intractable disease patients have in common is progression of disability. In particular, for patients who have difficulty in maintaining their posture, it is difficult to maintain the current status of operation devices and applications. Therefore designing of a device that can be adjusted with the user's operation characteristics in mind is desired. There are many prior studies for a method in which the machine adjusts to human [6] such as self-adjusting keyboard in view of the users' operation characteristics [4] or a skill enhancing effect by machine characteristic modification [5]. However, those studies do not present specific measures for intractable disease patients with a progressive disease.

In view of those issues, this study intends to assist users in accessing a PC by presenting a part of GUI's visual information as acoustic information. In particular, for patients with growing difficulty in keep viewing the screen as the disease condition develops, acoustic information is gradually added so that the users can understand the state even when they are not viewing the screen.

The approach of this study allows the user to select and determine next action without viewing the screen, thereby expecting the efficiency of the PC operation to be maintained as much as possible.

2. Information Presentation Using Auditory Signals of a Screen

2.1. Target of this Study

This study targets at patients who have difficulty in maintaining a posture due to progressive diseases and thus cannot keep sitting and maintaining the same posture in front of a PC. Although they are not totally incapable of viewing the screen, they have difficulty in keeping their eyes on the screen as they have to turn their heads or twist their bodies when changing posture. They will restore physical strength after a while and it becomes possible to face the PC again but the length of time they take their eyes off the screen gets inevitably longer.

Even when they are not facing the display, they can move their hands and other parts of the body, and thus can operate the mouse and the keyboard. For this reason, acquiring of screen-independent information by voice information using a screen reader is possible, but to such targets it is not rational to simply recommend a system that is for the visually impaired. It is well known that in terms of being screen-independent, a screen reader with voice synthesis device is useful. However, we have subjective evaluations indicating that it is rather bothersome for the users who can also acquire visual information to receive all the GUI-independent screen information via voice or sound.

Thus the main target of this study is not the visually impaired who are totally unable to view the screen or patients who use alternative devices such as head-mounted display. Basically, this study targets at patients who do not rely on special assist devices for the disabled and wish to continue to use general devices as long as possible as healthy people.

2.2. Introduction of the Concept of Soundscape

When using a PC, patients who have difficulty in maintaining a posture particularly wish to understand the state while they are not viewing the screen. In order to allow these users to understand the screen status, this study intends to build a system to notify the user of such information as to what application is running, what is being focused on, and what stand-by state as acoustic information of not by voice but by auditory signals even in a static state where nothing is operated. OSs such as Windows have a customizing function to output various auditory signals when an event is raised but its application range is limited and there is no effective tool to recognize screen information in a state where nothing is operated.

Auditory signals that users may feel as bothersome, noisy and annoying cannot assist a comfortable operation. This study is introduced with a concept of soundscape, in which sound is handled in the context of relationship between environment and human [7]. The word soundscape is a compound of "sound" and "scape," a suffix meaning "scene/scenery," thus meaning "sound scenery." This concept has been introduced into not only academic fields but

also environmental designing or art and cultural activities and the like.

Auditory signals in this study are output but preferably with a background at a level that doesn't bother users unless they become conscious of it. For example, a room ventilation fan makes negligible sounds but not really bothering. Even if some of such auditory signals overlap, at the time the users becomes conscious, they can immediately distinguish the sounds and can understand the state of the PC screen by the difference in meanings given to the sounds. Consequently, in this study, auditory signals are an important element. This coincides with the concept of soundscape where sounds are regarded as scenery. We expect to use some aspects of soundscape, i.e., emitting a sound that gently appeals to human consciousness and planting them as auditory signals and try to introduce them into a new field, the field of engineering.

3. Analysis of PC Operation

It is desirable that the system proposed by this study will be to put visual information in a complementary relationship with the screen reader that reads out text contents and screen information and not meant to replace every visual information with auditory information. For example, most of the information obtained or input via the Internet or a word processor becomes text contents. These are intuitively understandable when read out straight with synthesized voices and the like. However, even an application of which the main task is text display and character entry does not necessarily require the text to be read out continuously nor character entry operations to be continued without interval. In fact, a lot of times users turn their eyes away and rest from operations.

We asked patients who have difficulty in maintaining a posture to use the application they frequently use in their everyday life for us to conduct a simple verification experiment to find out how long it takes them to understand text information or character entry information on the screen. The test subject is a male in his thirties who has spinal progressive muscular atrophy and has been using PC for about 15 years. He can maintain a posture for about 10 min. He regularly uses a mailing tool (Outlook) so we asked him to use it in the way he does with usual concentration. We measured his operations from starting up to quitting, checking e-mails in the in-box then replying to those e-mails, Since we intended just a rough estimation, we measured on the visual and aural judgment by a third person who observed the test subject without using any accurate measurement device. During the experiment, a screen keyboard was actuated. When the test subject wanted to know the text contents or when he was entering the text, key actions were taken for the text to be articulated by the synthesized voice line by line and put to a stop immediately when unnecessary so that the reading out time was measured separately. Reading out speed became too fast for healthy people to understand because it was adjusted to the speed needed for the eyes to follow.